CLAIMS:

1. A variable displacement vane pump, comprising:

a housing defining a chamber, a pump inlet through which fluid enters the housing and a pump outlet through which fluid is discharged from the housing under pressure;

a containment ring or eccentric ring pivotably carried by the housing for movement between a first position and a second position and defining an opening with an internal surface;

a rotor carried by the housing for rotation relative to the internal surface and having a plurality of slots extending inwardly into the rotor from an exterior of the rotor;

a plurality of vanes carried by the rotor with each vane slidably received in a slot in the rotor;

a first actuator responsive to application of fluid under pressure and operable to pivot the containment ring or eccentric ring in a first direction; and

a second actuator responsive to application of fluid under pressure and operable to pivot the containment ring or eccentric ring in a second direction.

2. The pump of claim 1 wherein the first actuator is a piston slidably carried by the body and responsive to a first actuation pressure signal.

3. The variable displacement vane pump of claim 1 wherein said second direction is in a direction opposite of the first direction.

4. The pump of claim 1 wherein the second actuator is a piston slidably carried by the body and responsive to a second actuation pressure signal.

5. The pump of claim 2 wherein the second actuator is a piston slidably carried by the body and responsive to a second actuation pressure signal.

6. The pump of claim 1 wherein the first actuator includes a spring that yieldably biases the containment ring or eccentric ring in said first direction.

7. The pump of claim 1 which also comprises a seal between the containment ring or eccentric ring and the housing defining a fluid chamber between the housing and containment ring or eccentric ring with fluid under pressure in the fluid chamber defining the first actuator.

8. The pump of claim 7 which also comprises another fluid chamber defined at least in part by said seal with fluid under pressure in said another fluid chamber defining the second actuator.

9. The pump of claim 1 which also comprises a control valve responsive to a first fluid pressure signal to control application of said fluid under pressure to said first actuator, and responsive to a second fluid pressure signal to control application of said fluid under pressure to said second actuator.

10. The pump of claim 1 which also comprises a pivot pin about which the containment ring or eccentric ring pivots, said pivot pin defining a pivot axis of the containment ring or eccentric ring which is offset from the axis of the rotor by about one-half the maximum eccentricity of the containment ring or eccentric ring relative to the rotor.

11. The pump of claim 1 which also comprises an inlet flow valve responsive to a fluid pressure signal above a threshold pressure to permit a portion of fluid discharged from the pump outlet to flow into the pump inlet during at least some fluid flow conditions.

12. The pump of claim 11 wherein the inlet flow valve is yieldably biased to a position preventing fluid discharged from the pump outlet to flow into the inlet of the pump and is displaced by a sufficiently high fluid pressure signal to a position permitting fluid discharged from the pump outlet to flow into the pump inlet.

13. The pump of claim 1 which also comprises a vane extension member carried by the housing and engageable with the vanes during at least certain positions of the rotor to ensure that at least two vanes extend outwardly from the exterior of the rotor at all times.

14. The pump of claim 13 wherein the vane extension member is a ring carried by the rotor to engage at least two vanes at all times.

15. The pump of claim 1 wherein the slots in the rotor extend radially inwardly of the rotor.

16. The pump of claim 7 wherein the seal is defined by direct contact between the containment ring or eccentric ring and the housing.

17. The pump of claim 7 wherein the seal is carried by the containment ring or eccentric ring.

18. The pump of claim 7 wherein the seal is carried on the housing.

19. The pump of claim 12 wherein fluid under pressure is communicated with the slots in the rotor to bias the vanes into contact with the cam surface.

20. The pump of claim 13 wherein the vane extension member further comprises a ring portion for engaging said two rings and oil pressure acting on the said vanes for extending the van outwardly.

21. The pump of claim 9 which also comprises an exhaust opening in the housing through which fluid in the fluid chamber is discharged under certain fluid flow conditions and wherein the control valve controls fluid flow from the fluid chamber through the exhaust opening in response to certain fluid pressures of said first and second pilot pressures.

22. The pump of claim 1 wherein the vanes have leading and trailing faces and the slots in the rotor are slightly wider than the vanes received in said slots so that a fluid film forms between the rotor and the leading and trailing faces of each vane.

23. The pump of claim 22 which also comprises a seal between a vane and the rotor to restrict fluid flow between them.

24. The pump of claim 23 wherein said seal is formed by contact between the vane and rotor.

25. The pump of claim 12 wherein the inlet flow valve is biased by a spring.

26. The pump of claim 25 wherein the inlet flow valve is further biased by a pilot pressure signal.

27. A variable displacement vane-type fluid pump, comprising:

a housing defining a pump inlet through which fluid enters the pump, a pump outlet from which fluid is discharged under pressure and a fluid chamber between the pump inlet and pump outlet;

a containment ring or eccentric ring pivotably carried by the housing within the fluid chamber for movement between a first position and a second position, said containment ring or eccentric ring having an interior opening with an internal surface;

a rotor carried by the housing at least in part in the interior opening of the containment ring or eccentric ring, driven for rotation relative to the internal surface and having a plurality of slots extending radially inwardly into the rotor from an exterior of the rotor;

a plurality of vanes carried by the rotor with a vane slidably received in each slot in the rotor;

a first actuator responsive to a first fluid pressure and operable to pivot the containment ring or eccentric ring toward its first position;

a second actuator responsive to a second fluid pressure and operable to pivot the containment ring or eccentric ring toward its second position; and

a control valve responsive to a first pilot pressure to control application of said first fluid pressure to said first actuator, and responsive to a second pilot pressure to control application of said second fluid pressure to said second actuator.

28. A variable displacement vane-type fluid pump, comprising:

a housing defining a pump inlet through which fluid enters the pump, a pump outlet from which fluid is discharged under pressure and a fluid chamber between the pump inlet and pump outlet;

a containment ring or eccentric ring pivotably carried by the housing for movement between a first position and a second position and defining an internal surface;

a rotor carried by the housing in the fluid chamber for rotation relative to the internal surface and having a plurality of slots extending inwardly into the rotor from an exterior of the rotor;

a plurality of vanes carried by the rotor with a vane slidably received in each slot in the rotor;

a first actuator responsive to a first control pressure and operable to pivot the containment ring or eccentric ring in a first direction;

a second actuator responsive to a second control pressure and operable to pivot the containment ring or eccentric ring in a second direction;

a control valve responsive to a control pilot pressure to control application of said first fluid pressure to said first actuator, and responsive to a second control pressure to control application of said second fluid pressure to said second actuator; and

a vane extension member carried by the housing and engageable with the vanes during at least certain positions of the rotor to ensure that at least one vane extends outwardly from the exterior of the rotor at all times.

29. The variable displacement vane-type fluid pump of claim 28 wherein said first actuator is a chamber formed between a portion of said containment ring and a portion of said housing.

30. A variable displacement vane-type fluid pump, comprising:

a housing defining a pump inlet through which fluid enters the pump, a pump outlet from which fluid is discharged under pressure and a fluid chamber between the pump inlet and pump outlet;

a containment ring or eccentric ring pivotably carried by the housing within the fluid chamber for movement between a first position and a second position, said containment ring or eccentric ring having an interior opening with an internal surface;

a rotor carried by the housing at least in part in the interior opening of the containment ring or eccentric ring, driven for rotation relative to the internal surface and having a plurality of slots extending radially inwardly into the rotor from an exterior of the rotor;

a plurality of vanes carried by the rotor with a vane slidably received in each slot in the rotor;

a first actuator responsive to a first control pressure and operable to pivot the containment ring or eccentric ring toward its first position;

a second actuator responsive to a second control pressure and operable to pivot the containment ring or eccentric ring toward its second position; and

a control circuit responsive to engine conditions for providing a variable targeting of pump output wherein pressure from the oil circuit in the engine acts on the first actuator and pressure from the outlet acts on the second actuator for variable control of the containment ring in response to these conditions.

31. The variable displacement vane-type fluid pump of claim 30 wherein said control circuit includes an actuator operatively connected to one of said actuators for moving said containment ring in response to the control pressures.

32. A variable displacement vane pump, comprising:

a housing defining a chamber, a pump inlet through which fluid enters the housing and a pump outlet through which fluid is discharged from the housing under pressure;

a containment ring or eccentric ring pivotably carried by the housing for movement between a first position and a second position and defining an opening with an internal surface;

a rotor carried by the housing for rotation relative to the internal surface and having a plurality of slots extending inwardly into the rotor from an exterior of the rotor;

a plurality of vanes carried by the rotor with each vane slidably received in a slot in the rotor;

a first actuator responsive to application of fluid under pressure and operable to pivot the containment ring or eccentric ring in a first direction; and

a second actuator responsive to application of fluid under pressure and operable to pivot the containment ring or eccentric ring in a second direction;

wherein said first and second actuators are fluid acting directly on said containment ring.